

REMARKS

The Examiner has rejected claims 1-3 under 35 U.S.C. 103 over Ergun et al. (US Publ. 2002/0013486). The Examiner takes the position that it would have been obvious for one skilled in the art to formulate the present invention upon a reading of Ergun. Applicants respectfully submit that this is not the case, since certain key features of the present invention are not taught or suggested by this reference.

The present invention relates to a method for improving the long term stability of biodiesels. The method comprises:

- (a) forming a reaction mixture comprising a crude methyl ester, by transesterification of a vegetable or animal fat or oil with methanol,
- (b) forming a layer containing the crude methyl ester of step (a), and separating the layer from the rest of the reaction mixture,
- (c) intensively inline mixing the crude methyl ester layer obtained in step (b) at temperatures between 25 and 60°C with a strong acid or with a mixture of a strong acid and a complex former, to form an emulsion, and
- (d) separating an ester layer from the emulsion formed in step (c), and then subjecting the separated ester layer to a thorough water wash and a subsequent drying.

Ergun relates to the production of fatty acid methyl ester using their particular arrangement of equipment. They specifically seek to avoid the strategic and logistical disadvantages of known methods, which require long production time, expansive space requirements, high static cost, and risk of contamination. This differs from the goal of the present invention, which aims at improving the properties of the end product itself, specifically improving long-term stability of biodiesels by reducing flocculation inducing crystallization nuclei.

The present invention teaches a first step (a) which includes a transesterification with a vegetable or animal fat or oil and methanol, to form a reaction mixture comprising crude

methyl ester. Ergun indeed teaches a transesterification step within their apparatus, in which vegetable or animal fats are mixed with an alkaline solution and dissolved in methanol. However, Ergun teaches that their mixture goes through an *emulsification* and *transesterification* within the same reaction section of their apparatus. Thus, the emulsification and transesterification are conducted together. This clearly differs from the present invention, which teaches that after the formation of the reaction mixture comprising crude methyl ester via transesterification, a layer having the crude methyl ester is formed, and is *separated* from the rest of the reaction mixture. In step (c), the separated crude methyl ester layer is then intensively inline mixed at 25-60°C with a *strong acid* or a mixture of a strong acid and a complex former, to form an emulsion. Thus, the present claims teach the formation of an emulsion in a step *subsequent* to the transesterification, unlike Ergun. In addition, Ergun does not teach the inline mixing of a *strong acid* at the required temperatures to form an emulsion. Finally, the step (d) of the present claims requires the separation of an ester layer from the emulsion of step (c), followed by subjecting the ester layer to a thorough water wash and a subsequent drying. Such is not taught anywhere by Ergun. Thus, it is submitted that the sequence of steps required by the present claims has not been taught or suggested by Ergun, and would not have been obvious to one of ordinary skill upon a reading of Ergun in view of the general knowledge in the art.

The Examiner agrees that Ergun fails to subject a crude methyl ester to *intensive inline mixing* with a *strong acid*, at a temperature between 25 and 60°C. However, he goes on to assert that paragraph 0005 of Ergun discloses certain prior art where a transesterified liquid is neutralized with phosphoric acid, citric acid, or other acids, and whereby soap and the potassium salts of the acids are sedimented. However, it is urged that the usage of such acids in this cited art, which art is *not* cited by the Examiner in the present case, differs *drastically* from the present invention. That is, paragraph 0005 of Ergun states that the *acid* in such a prior art method is used for neutralization and precipitation, and not that an intensive inline mixing occurs at the presently required temperatures, nor that an *emulsion* is formed, which is a key feature of the present invention. Further, Ergun states that the prior art processes use a *sedimentation* method, where the phases are mixed

but formation of an emulsion is avoided. The reason for this is based on the fear that the emulsion becomes too stable and will not break into two original phases. The motivation to avoid the formation of an emulsion using this sedimentation method is disclosed in paragraph 0015, where it is stated that the sedimentation time would be “too long due to the fine distribution of the drops”. This teaches away from the presently claimed invention. That is, the present invention intentionally avoids these known traditional methods of avoiding the formation of an emulsion at that stage. An emulsion is *intentionally* formed in the present method, by the use of an intensive inline mixing apparatus. It has been surprisingly found that, contrary to traditional anticipation, the present emulsion does not fail to break. After the breaking of the emulsion, a stable interphase remains between the washed ester phase and the heavy wash phase. This unexpected result would not have been anticipated by one of ordinary skill in the art upon a reading of Ergun, since the reference points in a totally different direction.

The Ergun reference further states that transesterified liquid can be rinsed with water to absorb the soap and potassium solution (see paragraph 0005), but it is explicitly stated that there are still some *contaminants* present in the fuel (see paragraph 0006). It is also mentioned that other subsequent cleaning steps are possible, which is a clear indication that contaminants are still present in the fuel. Therefore, while Ergun involves a method which attempts to solve the problems of long production times and allows for economic production of materials (see paragraph 0005 – 0011), they do not address the problems which are solved by the present invention, namely those relating to the long-term stability properties of the end product itself.

To solve the production time problems of the prior art, Ergun proposes an alternative method wherein the reaction is accelerated by enlarging the boundary surfaces. As stated in paragraph 0015, these steps of Ergun result in a “shortening of the production time”. After a separation of the emulsion phases, the fatty acid methyl ester can subsequently be cleaned (see paragraph 0024). The cleaning is achieved by multiphase distillation, such as vacuum distillation, standard evaporation, thin-layer evaporation, or fractionated condensation (see paragraphs 0031-0034), whereby residues are separated from the fatty

acid methyl ester, and methanol is removed at the same time. It is neither mentioned in the text of Ergun nor is it obvious to use *strong acids* followed by water washing and drying, to clean a fatty acid methyl ester. Applicants thus urge that it would not have been obvious to one of ordinary skill in the art to formulate this sequence of steps required by the present claims, in view of the teachings of Ergun which specifically state that the prior art process which use certain neutralizing acids encounters *several disadvantages*, such as the requirement that *further* cleaning steps are conducted, and that *contaminants* remain in the obtained fuel product (see paragraph 0006).


Furthermore, Ergun clearly states that the method of their invention is *not suited* for such prior art sedimentation methods (see paragraph 0015). Since this is so explicitly stated, it would clearly *not* have been obvious for one skilled in the art to mix a fatty acid methyl ester obtained by a sedimentation method with a *strong acid*, in combination with the emulsion-formation taught by Ergun, much less to subject the ester layer to a water washing and subsequent drying. The use of such prior art methods would clearly encounter disadvantages which the Ergun reference seeks to avoid, such as long production time, space requirements, and the risk of contamination of the fuel (see paragraphs 0005 –0006). Clearly the use of a strong acid in a sedimentation method directly contrasts the teachings and goals of Ergun. Applicants therefore submit that the Examiner is actually attempting to insert the teachings of the known art which Ergun teaches against and deems ineffective, into the invention of Ergun itself. It is thus submit that the Examiner is impermissibly reconstructing the art in light of Applicant's disclosure, with no suggestion or motivation to do so.

Applicants respectfully submit that the prior art mentioned within Ergun does not at all take away from the inventive step of the present invention. It addresses completely different technical problems, which require completely different process steps to provide adequate solutions. It is urged that one skilled in the art would not be inspired to formulate the present invention upon a reading of Ergun. It is therefore respectfully

requested that the 35 U.S.C. 103 rejection be withdrawn.

The undersigned respectfully requests re-examination of this application and believes it is now in condition for allowance. Such action is requested. If the Examiner believes there is any matter which prevents allowance of the present application, it is requested that the undersigned be contacted to arrange for an interview which may expedite prosecution.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Marisa A. Roberts", written over a horizontal line.

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